WOODCOCK RESEARCH AND MANAGEMENT

1966

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
Special Scientific Report--Wildlife No. 101

UNITED STATES DEPARTMENT OF THE INTERIOR, STEWART L. UDALL, *Secretary*
Stanley A. Cain, *Assistant Secretary for Fish and Wildlife and Parks*
Fish and Wildlife Service, Clarence F. Pautzke, *Commissioner*
Bureau of Sport Fisheries and Wildlife, John S. Gottschalk, *Director*

WOODCOCK RESEARCH AND MANAGEMENT, 1966

Compiled by William H. Goudy
Migratory Bird Populations Station
Division of Wildlife Research

Drawings by Leta R. Goudy

Special Scientific Report—Wildlife No. 101
Washington, D. C. · April 1967

CONTENTS

ABSTRACT

Surveys designed to determine the population status of American woodcock indicate little change in recent continental breeding populations, but a continuing decline in production. The annual harvest of this species, meanwhile, continues to soar with an apparent upsurge in hunters' awareness of the woodcock's sporting qualities. Research activities continue to uncover information related to the reliability of singing-ground surveys while banding operations in Louisiana, Maine, Michigan, and West Virginia testify to the feasibility of expanding this very important program throughout North America. West Virginia has contributed significantly to this program through its improvement of the night-lighting technique which was developed in association with their primary objective of evaluating the importance of hunting as a mortality factor. Woodcock bandings and recoveries from the Moosehorn National Wildlife Refuge are being examined to determine more about the characteristics of this lightly harvested population and to better understand their use of various habitat types.

WOODCOCK RESEARCH AND MANAGEMENT, 1966

The secretive, sombre-colored American woodcock (Philohela minor Gmelin) is one of our finest game birds as well as being a special attraction to non-hunters. The nesting female serves as an excellent model for photographers, while the male's spectacular courtship antics provide many hours of refreshing observation on warm, spring evenings. The woodcock provides most of its recreation from early September to the end of January as its darting shadow challenges both the novice and the experienced hunter. To many of the latter, woodcock are a favorite game bird even though most hunters consider them as an incidental (but welcome) addition to their primary bag of ruffed grouse, bobwhite quail, pheasants, or rabbits. Its habitat and flushing characteristics usually cause many rounds of ammunition to be expended before a daily bag of five birds has been obtained. Thus, the American woodcock must be considered as having economic as well as esthetic value.

This report summarizes recent activities concerned with woodcock research and management programs and plans throughout North America. We sincerely thank those who have contributed to this publication. Although special appreciation is expressed to the authors of the articles appearing on the following pages, sincere gratitude is also extended to those who take the time each spring to conduct singing-ground surveys in both the United States and Canada.

Figure 1.--West Virginia Game Biologist Robert C. Kletzly releasing a newly banded woodcock which was captured in a mist net (photo courtesy West Virginia Department of Natural Resources —— Hal Dillon photographer).

THE 1966 STATUS OF AMERICAN WOODCOCK AND RECENT POPULATION TRENDS

William H. Goudy
Research Biologist
Migratory Bird Populations Station
Laurel, Maryland

Two major surveys are conducted in eastern North America each year to obtain information concerning the population status of American woodcock. A singing-ground survey, conducted each spring in most States and Provinces where woodcock nest, provides an index to the size of the breeding population. During the hunting season, the wing-collection survey is conducted to obtain an index of reproductive success and to appraise changes in the geographic distribution and size of the harvest. The wing-collection survey also provides information necessary in establishing effective regulations.

This report summarizes results of recent woodcock singing-ground and wing-collection surveys.

SINGING-GROUND SURVEY

Breeding Population Index - Singing-ground counts have been conducted annually throughout much of North America's primary woodcock nesting range since 1953. These surveys are conducted primarily to determine changes in the spring breeding population. Techniques and methods employed in this survey have been thoroughly discussed in previous Special Scientific Reports (Robbins 1960; Martin 1961, 1962, 1963, and 1964; and Goudy and Martin 1966).

An index to the 1966 population was obtained from 188 comparable survey routes conducted in 18 States and 2 Provinces. Results from this survey indicated a "singing" male population very similar to 1965's (table 1). A comparison of recent

woodcock breeding population indexes obtained from comparable singing-ground survey routes, between adjacent years, is presented in table 2. When these values are combined and adjusted to the 1965 index (as the base year), a gradually increasing breeding population is suggested (fig. 2-A).

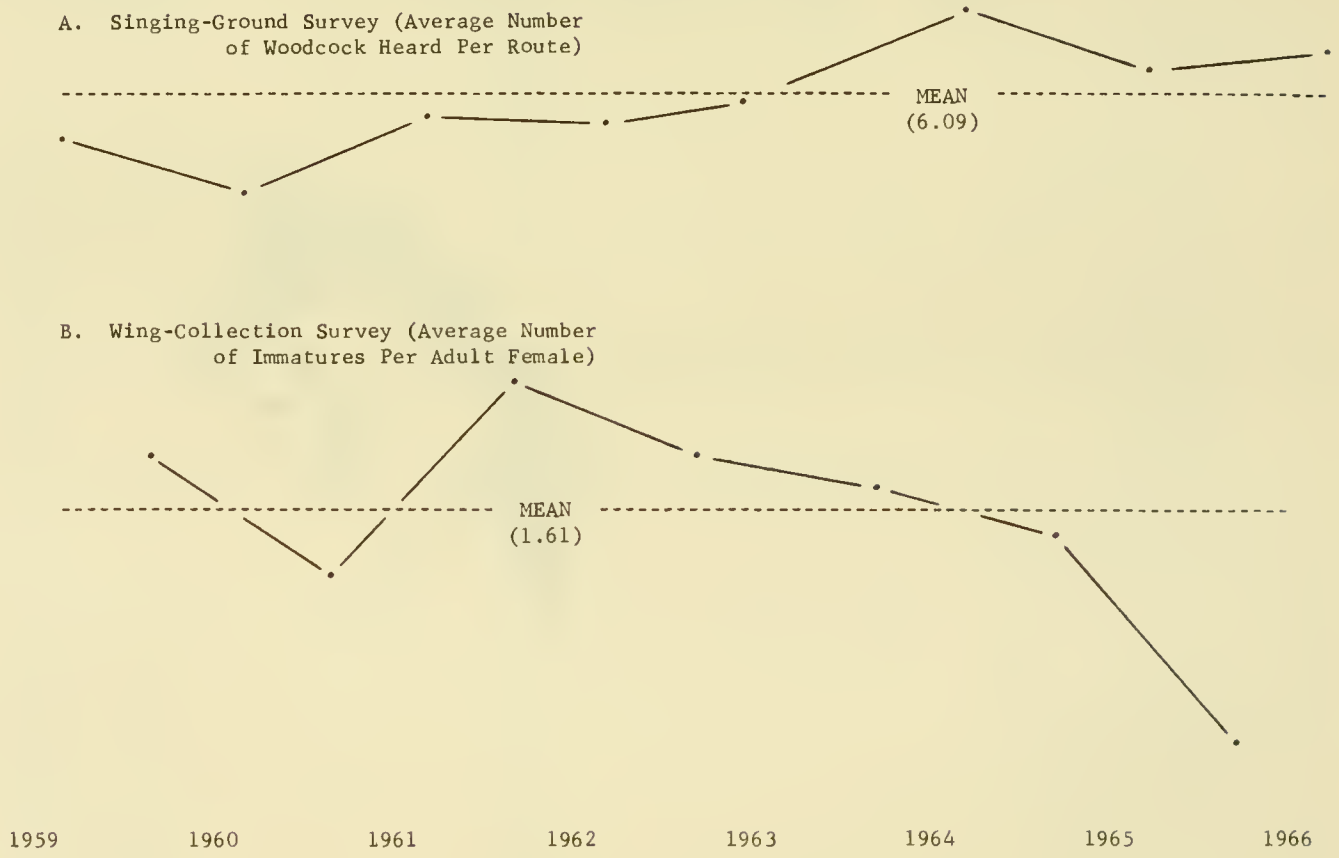
WING-COLLECTION SURVEY

Productivity Index - Reproductive success is usually measured by the ratio of immature birds to adult females in the fall bag. Woodcock can be aged and sexed by examining their wing feathers; therefore, a wing-collection survey was initiated in 1959 to determine breeding success and to evaluate changes in annual productivity.

Prior to each hunting season, woodcock wing-collection envelopes are mailed to hunters who sent in wings during the previous season. A sample of "duck stamp" purchasers, who indicated in the Waterfowl Kill Survey that they also hunted woodcock, have been asked to participate in the Woodcock Wing-Collection Survey since 1965. By combining the information received from these two sources, we attempt to obtain wings from all 32 States that provide woodcock hunting opportunities. The Canadian Wildlife Service also distributes envelopes to some of their hunters that pursue this fine game bird. The response of hunters during past hunting seasons has been outstanding and they have contributed an average of over 12,000 wings annually (table 3). Last year (1965-66 hunting season), 11,947 woodcock wings were received at the Migratory Bird Populations Station from 1,001 cooperating hunters (table 4).

The number of immatures per adult female has varied considerably among States and Provinces (table 5), and within these harvest areas, between years (Goudy and Martin 1966). This variation was probably caused by differences in hunting season dates, varying weather conditions, and extreme fire conditions which restricted hunting seasons. Nevertheless, during the first 6 years of this survey, age ratios in the North American kill did not vary more than 4 percent from an adjusted weighted mean of

Figure 2.--Trends in Woodcock Breeding Populations and Productivity in North America



1.63 immature birds per adult female. However, age ratios from woodcock shot during the 1965 hunting season decreased almost 9 percent from those obtained in 1964 (table 6). Since age ratios derived from a wing-collection survey can be seriously affected by such things as differential vulnerability and migration, it is quite possible that no real change occurred in 1965's woodcock production. It should also be noted, though, that this is the fourth consecutive year that this survey has indicated a lower ratio of immatures in the fall bag (fig. 2-B).

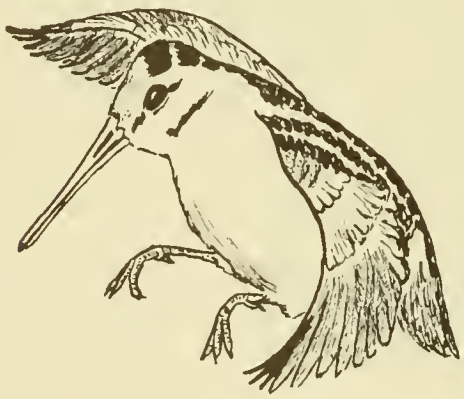


Table 1.--Woodcock breeding population indexes as indicated by singing-ground surveys in 1965 and 1966

State or Province	Total number of routes conducted		Number of comparable routes	Number of woodcock heard per comparable route		Percent change in woodcock heard per route from 1965
	1965	1966		1965	1966	
EASTERN REGION						
Connecticut	13	12	9	3.67	3.22	
Delaware	1	4	1	5.00	5.00	
Maine	42	43	32	9.00	8.63	
Maryland	3	26	2	6.50	3.50	
Massachusetts	8	8	6	8.67	7.50	
New Brunswick	6	9	2	11.00	7.50	
New Hampshire	13	13	3	3.33	3.33	
New Jersey	5	5	3	6.00	6.67	
New York	36	29	18	6.89	6.72	
North Carolina	13	0	0	--	--	
Nova Scotia	23	30	12	8.00	8.00	
Pennsylvania	26	23	14	7.29	7.86	
Prince Edward Is.	3	3	0	--	--	
Vermont	5	5	4	5.75	9.50	
REGIONAL TOTS. & WEIGHTED AVG.*	197	210	106	7.43	7.61	+2.4%
WESTERN REGION						
Illinois	5	5	2	3.50	4.50	
Indiana	10	14	2	12.00	13.00	
Iowa	10	13	4	1.50	3.50	
Kentucky	10	0	0	--	--	
Michigan	121	135	17	4.71	5.59	
Minnesota	23	14	9	5.00	3.67	
Ohio	10	8	7	4.29	4.00	
Ontario	2	0	0	--	--	
West Virginia	62	51	30	0.83	0.80	
Wisconsin	16	16	11	5.00	5.09	
REGIONAL TOTS. & WEIGHTED AVG.*	269	256	82	3.82	3.80	-0.5%
NORTH AMERICAN TOTS. & WEIGHTED AVG.*	466	466	188	6.01	6.11	+1.7%

* Weighted indexes are obtained by multiplying woodcock heard per comparable route with a factor based on land area represented by at least 10 routes or where one comparable route represented 2,100 square miles or less.

Table 2.--Comparison of recent woodcock breeding population indexes as indicated by singing-ground surveys

Years of comparison	EASTERN REGION			WESTERN REGION			CONTINENTAL NORTH AMERICA		
	Comparable routes	Birds heard per route	Percent change	Comparable routes	Birds heard per route	Percent change	Comparable routes	Birds heard per route	Percent change
1959 1960	166	7.14 6.43	-10%	40	5.29 5.68	+ 7%	206	6.18 6.06	- 2%
1960 1961	150	5.88 6.46	+10%	73	5.49 5.92	+ 8%	223	5.66 6.16	+ 9%
1961 1962	148	6.43 6.21	- 3%	115	5.46 5.44	0%	263	5.87 5.76	- 2%
1962 1963	161	6.19 5.76	- 7%	118	5.39 6.25	+16%	279	5.72 6.04	+ 6%
1963 1964	153	6.49 6.96	+ 7%	133	6.29 7.10	+13%	286	6.37 7.04	+11%
1964 1965	151	6.94 6.91	0%	133	6.73 5.98	-11%	284	6.82 6.38	- 6%
1965 1966	106	7.43 7.61	+ 2%	82	3.82 3.80	- 1%	188	6.01 6.11	+ 2%

Table 3.--Total number of wings received from the last three woodcock wing-collection surveys

State or Province of harvest	Hunting Season		
	1963	1964	1965
Arkansas	0	0	6
Connecticut	422	419	539
Florida	0	0	17
Georgia	0	0	5
Illinois	0	0	2
Indiana	61	56	35
Kentucky	3	0	2
Louisiana	372	188	137
Maine	1,802	2,852	2,116
Maryland	14	3	30
Massachusetts	514	566	454
Michigan	1,796	1,684	1,184
Minnesota	545	431	237
Mississippi	0	0	5
Missouri	1	2	3
New Brunswick	1,065	660	446
New Hampshire	370	693	745
New Jersey	778	795	823
New York	874	1,654	1,602
North Carolina	0	0	19
Nova Scotia	75	184	154
Ohio	159	241	214
Ontario	837	1,053	669
Pennsylvania	750	1,430	847
Quebec	459	251	93
Rhode Island	66	59	41
South Carolina	0	0	8
Tennessee	0	0	5
Texas	0	0	2
Vermont	99	311	310
Virginia	0	3	3
West Virginia	140	315	381
Wisconsin	1,443	1,202	803
Unknown Areas	0	6	10
TOTAL WINGS	12,645	15,058	11,947
HARVEST AREAS	(23)	(23)	(33)

Table 4.--Woodcock wing-collection survey results; 1965 hunting season

State or Province of residence	Number of cooperators responding	Number of envelopes received	Number of wings received	Average number of wings per envelope	Average number of wings per cooperator
Arkansas	3	3	6	---	---
Connecticut	58	254	627	2.5	11
Delaware	1	1	1	---	---
Florida	4	16	22	---	---
Georgia	2	4	5	---	---
Illinois	3	4	4	---	---
Indiana	7	18	40	---	---
Kentucky	3	3	2	---	---
Louisiana	19	55	137	---	---
Maine	77	457	1,805	4.0	23
Maryland	8	26	56	---	---
Massachusetts	63	308	928	3.0	15
Michigan	94	376	964	2.5	10
Minnesota	32	82	298	3.5	9
Mississippi	4	4	4	---	---
Missouri	2	2	3	---	---
New Brunswick	16	50	373	---	---
New Hampshire	40	149	411	3.0	10
New Jersey	74	329	1,039	3.0	14
New York	135	476	1,381	3.0	10
North Carolina	4	12	19	---	---
Nova Scotia	11	22	151	---	---
Ohio	37	108	337	3.0	9
Ontario	56	168	681	4.0	12
Pennsylvania	93	322	863	2.5	9
Quebec	10	18	81	---	---
Rhode Island	13	47	101	---	---
South Carolina	3	5	7	---	---
Tennessee	1	1	5	---	---
Texas	1	1	2	---	---
Vermont	31	129	289	2.0	9
Virginia	1	1	1	---	---
West Virginia	12	39	70	---	---
Wisconsin	79	266	746	3.0	9
Special Areas*	4	14	488	---	---
TOTAL	1,001	3,770	11,947	3.0**	11.5**

* Special woodcock study and/or hunting areas in West Virginia (2), Michigan (2), and New York (1).
** Unweighted means (includes data from States and Provinces with less than 25 cooperators, but not data from the special areas).

Table 5.--Woodcock wing-collection survey age and sex ratios; 1965 hunting season

State or Province of harvest	AGE AND SEX CATEGORIES							Total wings received	Immature per adult female*
	Adult male	Adult female	Imm. male	Imm. female	Adult unk. sex	Immature unk. sex	Unk. age		
Arkansas	5	1	0	0	0	0	0	6	----
Connecticut	134	153	127	99	1	7	18	539	1.52
Florida	0	4	4	9	0	0	0	17	----
Georgia	0	0	1	4	0	0	0	5	----
Illinois	1	0	1	0	0	0	0	2	----
Indiana	7	11	13	4	0	0	0	35	----
Kentucky	0	2	0	0	0	0	0	2	----
Louisiana	16	38	32	46	0	0	5	137	----
Maine	426	599	482	481	21	20	87	2116	1.64
Maryland	2	4	12	10	1	1	0	30	----
Massachusetts	98	140	104	100	1	3	8	454	1.48
Michigan	241	370	254	258	5	3	53	1184	1.39
Minnesota	31	73	77	53	0	0	3	237	1.78
Mississippi	2	0	0	3	0	0	0	5	----
Missouri	1	1	0	1	0	0	0	3	----
New Brunswick	91	116	98	119	2	3	17	446	1.90
New Hampshire	164	209	168	168	3	4	29	745	1.63
New Jersey	164	216	176	186	4	4	73	823	1.69
New York	294	497	384	322	7	13	85	1602	1.45
North Carolina	4	8	2	5	0	0	0	19	----
Nova Scotia	24	37	39	48	0	0	6	154	----
Ohio	34	49	64	62	0	1	4	214	2.59
Ontario	170	200	132	141	2	3	21	669	1.38
Pennsylvania	145	250	203	209	8	14	18	847	1.70
Quebec	24	27	19	21	0	0	2	93	1.48
Rhode Island	3	9	16	12	0	0	1	41	----
South Carolina	3	3	1	1	0	0	0	8	----
Tennessee	1	1	2	1	0	0	0	5	----
Texas	0	0	1	1	0	0	0	2	----
Vermont	60	105	65	79	0	1	0	310	1.38
Virginia	1	0	2	0	0	0	0	3	----
West Virginia	71	94	108	94	5	4	5	381	2.19
Wisconsin	168	248	173	180	6	5	23	803	1.44
Unknown Areas	1	4	2	2	0	0	1	10	----
TOTAL	2,386	3,469	2,762	2,719	66	86	459	11,947	1.60**

* Unweighted age ratios from areas represented by at least 200 wings.
** Unweighted mean age ratio from all wings received.

Table 6.--Woodcock productivity indexes as indicated by age ratios determined from wings received from identical cooperators participating in the 1964 and 1965 wing-collection surveys

Area of harvest	Proportion of "total" kill	Number of wings received 1964	Number of wings received 1965	Immature per adult female* 1964	Immature per adult female* 1965	Percent change in weighted age ratios from the 1964 hunting season
Canada (by U.S. Cooperators)		55	60	--	--	
Connecticut		255	454	1.81	1.55	
Indiana		56	11	--	--	
Louisiana		68	80	--	--	
Maine**	.1032	1,818	1,682	1.72	1.67	
Massachusetts**	.0807	362	368	1.17	1.54	
Michigan**	.3725	937	871	1.40	1.39	
Minnesota		211	115	--	--	
New Hampshire		415	503	1.10	1.75	
New Jersey		426	631	1.57	1.53	
New York**	.2512	1,031	1,223	1.45	1.45	
Ohio		165	106	--	--	
Pennsylvania		822	618	1.85	1.65	
Rhode Island		17	36	--	--	
Vermont		206	229	--	--	
Wisconsin**	.1924	776	658	2.33	1.44	
TOTALS AND WEIGHTED AGE RATIOS**	1.0000	7,620	7,645	1.60	1.46	- 8.75%

* Computed only for harvest areas (States) represented by at least 250 wings.

** Age ratios are weighted by multiplying them with the proportion of estimated average total hunting kill from 1961-1964 for the five States indicated.

RELATION BETWEEN MALE COURTSHIP ACTIVITIES AND NESTING OF AMERICAN WOODCOCK

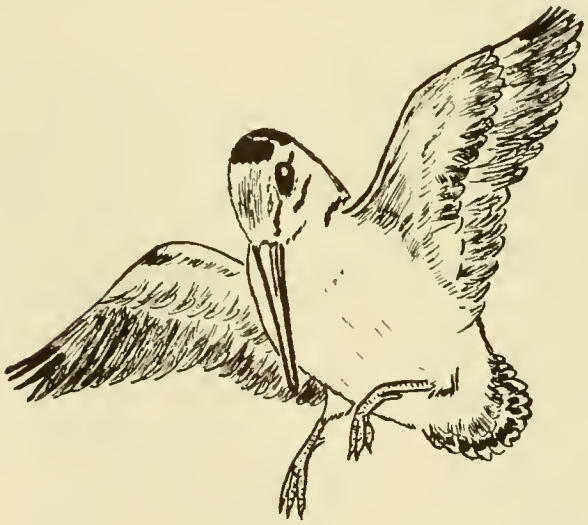
Aelred D. Geis
Assistant Director
Migratory Bird Populations Station
Laurel, Maryland

Counts made on the annual breeding population survey of woodcock depend on the conspicuous behavior of males in their "courtship performance." Male singing-ground activities begin prior to and during northern migration each spring and continue beyond the nesting period. Studies by Blankenship (1957), Goudy (1960), and Duke (1966) indicate that the time of nesting depends on whether the spring season is early or late, which also supports Mendall and Aldous' (1943) view that hatching dates are directly correlated with weather conditions. It is necessary to time the singing-ground survey so that it starts after migrants have left an area in order to obtain an unbiased measure of the resident woodcock population.

Recently, there has been concern about the accuracy of the singing-ground survey in the southern portions of the woodcock's breeding range. Some States have even discontinued their cooperation in the survey since they have felt the Bureau's suggested "time interval" for conducting singing-ground routes was too late to hear breeding males perform. The basis for this decision was the observation that many young birds were known to have hatched before the prescribed survey period. Some biologists have assumed that this presents a problem because experience with other species has demonstrated that male courtship performances either cease or are much reduced following the nesting period.

In Maryland, spring migration is judged to be complete by April 10, and the survey is conducted between this date and April 30. During the spring of 1966, a study area in the Piedmont Section near Clarksville, Maryland, was visited repeatedly to observe the duration of the courtship performance and its relation to associated nesting activities. On this area,

four to five males were regularly observed engaging in courtship activities through May 26, almost a month after the end of the singing-ground survey period. The "spring season" was late in 1966, probably causing an abnormally prolonged courtship period. On May 7th, two different woodcock broods were found which were already capable of flight and appeared nearly full grown. This means the chicks had to have hatched about April 20th, at least 35 days prior to the cessation of "singing" male activity. This indicates that the woodcock breeding population survey provides an index to the number of "singing" males long after the nesting period has been completed.



TRENDS IN THE CONTINENTAL WOODCOCK HARVEST

William H. Goudy
Research Biologist
Migratory Bird Populations Station
Laurel, Maryland

Analysis of various Bureau, State, and Provincial kill surveys indicates that more than a million woodcock were harvested in North America during the 1965 hunting season compared to an estimated kill of 300,000 eleven years ago. While the bulk of the U.S. harvest still occurs in the Northeastern and Lake States, the kill of woodcock in the Southeastern and Gulf States is also increasing. Following this discussion are separate reports of harvest trends and hunter interest in Maine, Pennsylvania, and Tennessee.

Hunter Success Index - A systematic method of appraising trends in the woodcock harvest has been attempted by determining the average number of wings returned by identical cooperators participating in the wing-collection survey for 2 consecutive years (table 7). Despite variations in woodcock shooting success among States each year, there was little change in the cooperator's average daily bag in 1963 and 1964 (Goudy and Martin 1966); but in 1965, their daily kill decreased almost 9 percent. The average number of wings submitted per season by these same cooperators, meanwhile, was larger in 1964 than in 1963 and resulted from more trips afield (Goudy and Martin 1966). In 1965, it appears as if the 4 percent decrease in total number of wings received from comparable hunters may have been due to woodcock not being as available in some areas as they were during the previous fall. A drop in daily and seasonal success by comparable hunters could be due to an increase in hunting pressure as well as a decrease in woodcock availability. However, since the woodcock kill by these hunters is relatively constant, the continuing "spiral" in the continental woodcock harvest has to be due primarily to an increase in the number of hunters participating in this form of recreation.

Waterfowl Questionnaire Index - Beginning in 1964, the Bureau's Waterfowl Kill Survey (a mail questionnaire to a sample of "duck stamp" purchasers) has included a question regarding the hunting of other migratory birds including woodcock. Analysis of 1964 and 1965 data has provided some insight into the annual magnitude and distribution of the woodcock harvest in the States that do not have kill surveys or do not request woodcock hunting information from their small-game hunters. It should be remembered that these data are based on information obtained from waterfowl hunters. The magnitude of woodcock hunting by non-duck stamp purchasers is not known in most States; therefore, these statistics provide only an indication to the hunting recreation provided by these migratory upland game birds. Listed below is the mean kill of woodcock in 1964 and 1965 by active adult "duck stamp" purchasers:

Michigan	= 68,000	New Jersey	= 11,000
Louisiana	= 50,000	Minnesota	= 8,000
Wisconsin	= 49,000	New Hampshire	= 8,000
New York	= 35,000	North Carolina	= 6,000
Pennsylvania	= 23,000	South Carolina	= 6,000
Maine	= 22,000	Texas	= 5,000
Massachusetts	= 21,000	Mississippi	= 5,000
Ohio	= 13,000	16 Others	= 38,000
Connecticut	= 12,000	TOTAL	= 380,000

There are several significant items to discuss in reference to the above table. First, on the basis of reliable State-conducted kill surveys, this waterfowl-woodcock index may be a fairly good indicator of the relative woodcock harvest among States. For instance, Michigan ranks first in the annual total woodcock harvest with a mean kill of about 165,000 during the 1964 and 1965 seasons. Wisconsin and New York also are high in this survey and their own mail questionnaires in recent years have indicated annual harvests of over 100,000. The big surprise in this survey is the high ranking Louisiana obtained. This suggests they are harvesting a minimum of 50,000 birds annually which makes them a very important harvest area as well as being "the" wintering concentration site for woodcock.

A "crude" estimate of the total U.S. woodcock harvest can be obtained by expanding these data on the basis of known woodcock kill and/or number of woodcock hunters in States that have reliable kill surveys. This expansion suggests that about 425,000 U.S. hunters harvested somewhere in the neighborhood of 900,000 woodcock during the 1965 hunting season (fig. 3). It is not our intent to imply that we are satisfied with this technique or the results obtained. However, until a sampling frame is available that will permit contacting a representative sample of woodcock hunters (such as the "duck stamp" provides for waterfowl hunters), estimates of total woodcock harvest and number of hunters will continue to be quite unreliable. The information in figure 3 is presented primarily to stress the increasing recreational opportunity woodcock are now affording in contrast with their popularity a decade ago. It is unfortunate that inadequate kill statistics make it inappropriate to present this information in greater detail.

Table 7.--Woodcock hunting-success indexes as indicated by the number of wings received from identical cooperators participating in the 1964 and 1965 wing-collection surveys

State of residence	Number of cooperators	Number of wings received		Average number of wings per envelope*		Average number of wings per cooperator*	
		1964	1965	1964	1965	1964	1965
Connecticut	37	281	536	2.5	2.7	7.6	14.5
Indiana	2	58	11	---	---	---	---
Louisiana	3	55	80	---	---	---	---
Maine**	49	1,643	1,436	5.1	4.1	33.5	29.3
Massachusetts**	36	683	742	3.3	3.3	19.0	20.6
Michigan**	58	861	760	3.1	2.7	14.8	13.1
Minnesota	11	288	154	---	---	---	---
New Hampshire	13	196	227	---	---	---	---
New Jersey	41	454	772	2.8	3.4	11.1	18.8
New York**	79	1,015	1,176	3.3	3.1	12.8	14.9
Ohio	13	249	219	---	---	---	---
Pennsylvania	62	889	639	3.4	2.7	14.3	10.3
Rhode Island	7	95	73	---	---	---	---
Vermont	12	151	201	---	---	---	---
Wisconsin**	53	702	622	3.2	3.0	13.2	11.7
TOTALS AND WEIGHTED AVERAGES**	476	7,620	7,645	3.4	3.1	16.3	15.6

* Computed only for States represented by at least 35 cooperators.

** Weighted averages are obtained by multiplying the proportion of estimated average total hunting kill from 1961-1964 for the 5 States indicated with the average number of wings received in these same States.

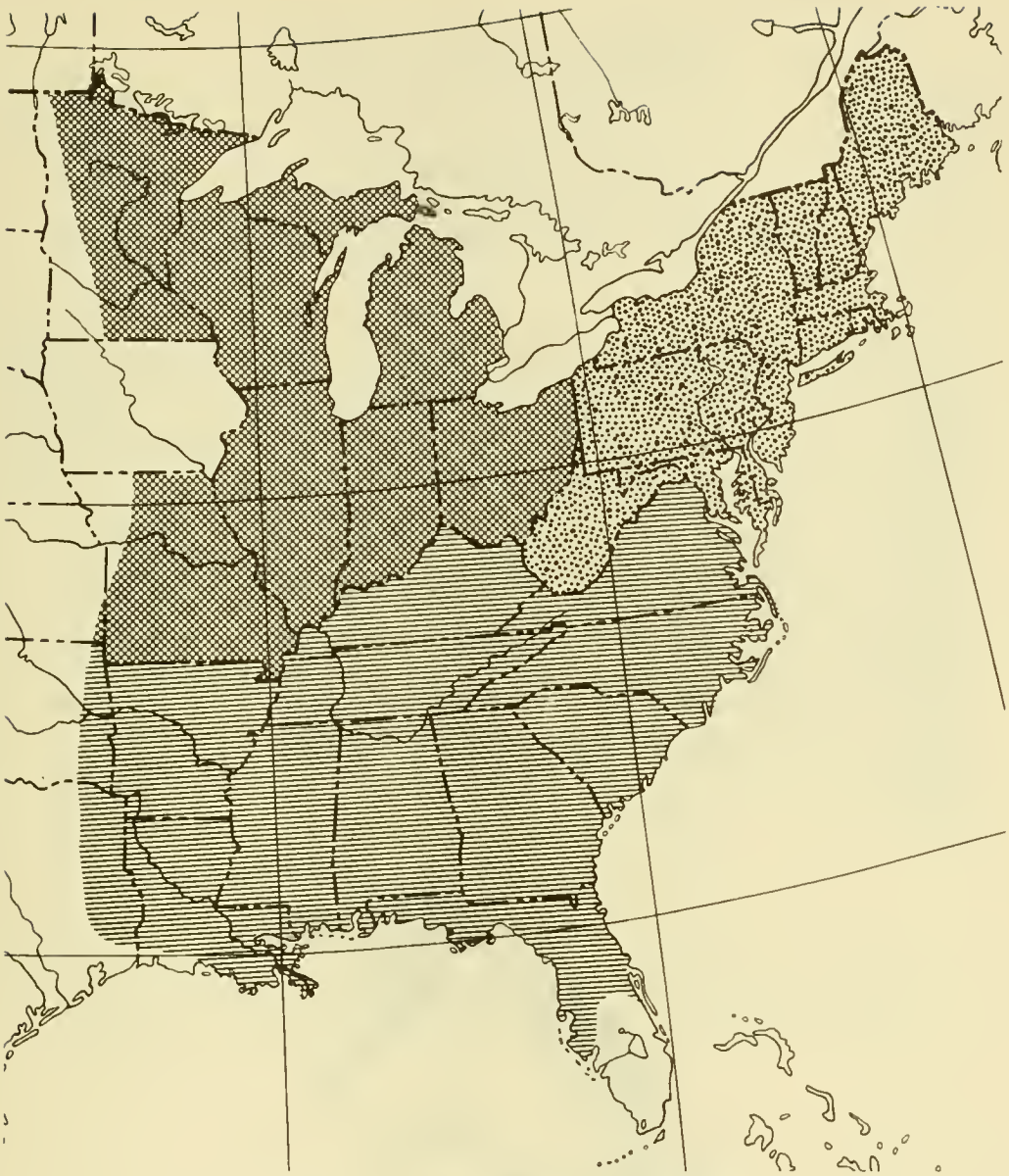


Figure 3.--1965 woodcock harvest and hunter interest by regions of the United States as indicated by State kill surveys and waterfowl hunter questionnaires.

TRENDS IN WOODCOCK HARVESTS AND HUNTER INTEREST IN MAINE

J. William Peppard
Regional Game Biologist
Department of Inland Fisheries and Game
Orono, Maine

A gradual increase in the number of woodcock hunters has resulted in a higher harvest of woodcock in Maine during recent years. Field investigations and our Game Kill Questionnaire confirm this. As may be seen in table 8, the woodcock harvest has increased from less than 11,000 in 1951 to almost 47,000 during the 1965 season. Since 1960, estimates of both the number of hunters and the annual kill have been calculated from mail questionnaires. Both estimates have increased quite constantly during recent years. Also, the survey has undoubtedly been more consistent from 1960 until the present time because the same person —— John D. Gill —— has been responsible for its operation. Gill also reports that, during these years, estimated numbers of deer and waterfowl hunters have not shown this increase in hunting effort.

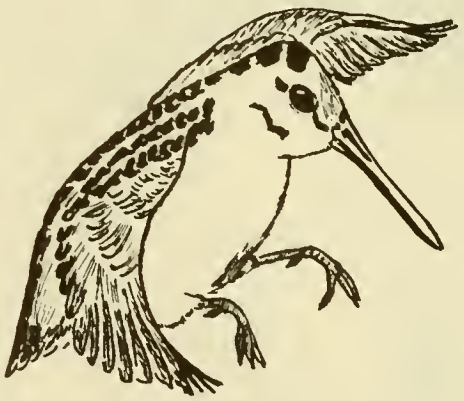


Table 8.--Woodcock kill and hunter participation in Maine

Hunting Season	NUMBER OF HUNTERS			Estimated Total Kill
	Resident	Non-Resident	Total	
1951	Unknown	Unknown	Unknown	10,900
1952	"	"	"	19,100
1953	"	"	"	25,000
1954	"	"	"	20,000
1955	"	"	"	23,000
1956	"	"	"	22,000
1957	"	"	"	21,000
1958	"	"	"	18,000
1959	"	"	"	28,500
1960	8,200	930	9,130	33,300
1961	7,200	1,100	8,300	32,100
1962	8,090	1,120	9,210	38,100
1963	8,100	825	8,925	31,000*
1964	9,200	1,200	10,400	43,800
1965	9,270	1,200	10,470	46,700

* Even though bag limits and season length were increased, forest fire hazards restricted hunting in many primary harvest areas during 10 days in late October.

RESUME' OF 1965's WOODCOCK HUNTING SURVEY IN PENNSYLVANIA

Stephen A. Liscinsky
Biologist
Pennsylvania Game Commission
State College, Pennsylvania

In 1964, the Pennsylvania Game Commission initiated a pilot study of grouse and woodcock hunting. This investigation was designed to provide information that would serve as a basis for measuring annual changes in shooting opportunities. The results of this initial survey were sufficiently rewarding to warrant continuation of the study.

Just prior to the 1965 small game season, 320 individuals who hunted grouse or woodcock were contacted by questionnaire. Approximately 60 percent of them responded by submitting a detailed report of their trips afield. This account constitutes an analysis of these records.

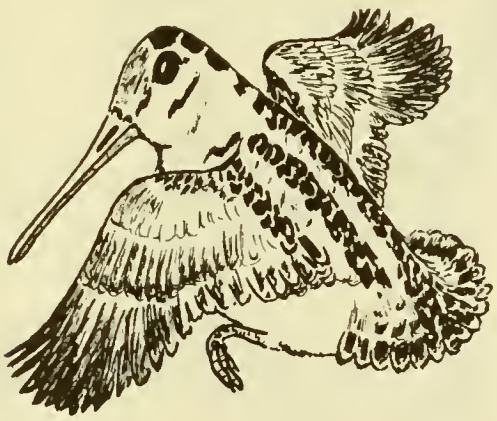
After the first few days of the woodcock season (which opened in mid-October, the same day as grouse season) most of the "cooperators" switched their efforts to hunting grouse. Nevertheless, a compilation of the reports shows that considerable time was exerted in hunting primarily for woodcock.

During 816 hours of hunting, 1,417 woodcock were flushed, 768 were shot at, and 421 killed. This constitutes 1.73 flushes per hour, 54 percent shot at, and 55 percent of the birds shot at were bagged.

Note.--This article was condensed from an article published in the September 1966 issue of the Pennsylvania Game News.

Flushing rates varied from place to place and as the season progressed. Flushes per hour, by region were: Central - 2.42, Northeast - 1.41, and Northwest - 1.20. The Statewide flushing rates by weeks of the season (first to fourth), were: 1.88, 1.88, 1.60, and 1.18.

Despite their playing "second fiddle" to the wild turkey and ring-necked pheasant in Pennsylvania, woodcock and grouse continue to afford the rugged individualist many hours of enjoyable recreation.



TENNESSEE'S WOODCOCK INVESTIGATIONS - 1966

Eugene Legler, Jr.
Leader, Wildlife Investigations Project
Game and Fish Commission
Nashville, Tennessee

In an effort to aid in the Bureau of Sport Fisheries and Wildlife's Woodcock Productivity Study, Tennessee quail hunters were asked to submit wings from any woodcock they might shoot during the 1966 hunting season. The hunters contacted were participating in the Commission's annual quail wing-collection survey and they responded by submitting a total of 4,835 quail and 57 woodcock wings. Sixteen wings were obtained from other sources resulting in 73 woodcock wings from 35 different Tennessee hunters. Age and sex categories determined from these wings follow:

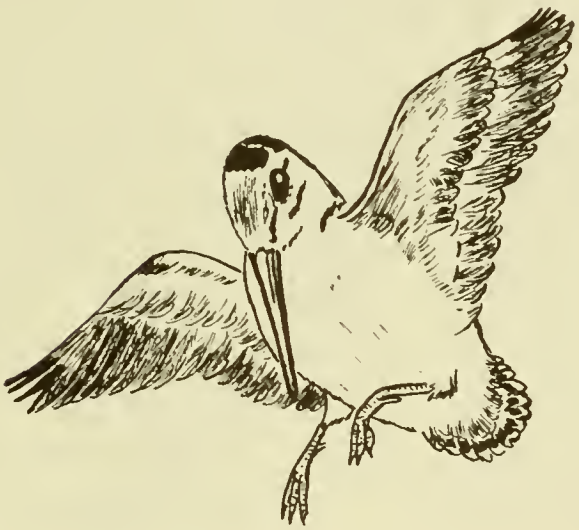
Adult Male	Adult Female	Immature Male	Immature Female	Age Unknown	Total Wings
22	16	15	12	8	73

The resulting productivity index ratio of 1.69 immatures per adult female is quite realistic even though the sample size is small. Last year's (1965) continental unweighted mean age ratio, from almost 12,000 woodcock wings examined by the Bureau, was 1.60.

Distribution of the woodcock kill in this sample shows that none was obtained from the far eastern or western counties. More than half were shot in the middle counties; with the plateau counties of Cumberland and Bledsoe also ranking high.

The 1966-67 woodcock season in Tennessee ran from November 21 through January 9, and 75 percent of the wings submitted were obtained during the first 7 days of the season. Only four cooperators shot woodcock on more than one day, and even though the average season harvest was just over 2 birds per hunter, one hunter achieved the daily bag limit of 5.

Although woodcock are not considered important game birds in Tennessee, it is quite likely that about 10,000 are harvested annually by hunters primarily in pursuit of rabbits, quail, and ruffed grouse.



A SUMMARY OF WOODCOCK HEN AND CHICK BANDING IN MICHIGAN

George A. Ammann
Game Ornithologist
Department of Conservation
Lansing, Michigan

Woodcock hens and chicks are being banded in Michigan to assist in determining whether there are homogeneous population units within the breeding range of this species (fig. 4). The primary objectives of this program are to determine harvest rates of woodcock produced in Michigan and to relate these production areas with their related harvest areas.

The capture of woodcock hens and their chicks also provides extremely valuable supplemental information on nest and brood densities, habitat preferences, hatching dates, brood size, movements, and dispersal.

Non-technical help has been solicited to band woodcock the past two springs. Although relatively few woodcock have been banded to date, judging from the enthusiasm shown, the program shows great promise. A total of 270 woodcock (24 adult hens and 246 chicks) was banded during 1965 and 1966 compared to an average of 43 during each of the previous 4 springs. The most successful, individual banders for the past 2 years have been:

Andy Ammann	73	Jack & Bill Wicksall	12
Tom Prawdzik	58	Al Schrader	10
Walt Palmer	33	Art Fleetwood	9
Frank Kargol	31	Charlie Cook	7
Al McLain	22	5 Others	15

Figure 4.--Michigan Game Biologist Dr. G. A. Ammann securing band on a woodcock chick (photo courtesy Michigan Department of Conservation — Oscar Warbach photographer.

WOODCOCK SUMMER BANDING OPERATIONS AT THE MOOSEHORN NATIONAL WILDLIFE REFUGE, MAINE

Eldon R. Clark
Wildlife Management Biologist
Moosehorn National Wildlife Refuge
Calais, Maine

In 1962, Bureau Biologist Fant Martin demonstrated that significant numbers of woodcock could be caught and banded at Moosehorn National Wildlife Refuge during the summer months using mist nets, spot-lights, and ground traps (Martin and Clark 1964). The success of this experimental phase led to the initiation of an intensive trapping and banding program in the summer of 1963 which has continued through the summers of 1964, 1965, and 1966.

Recoveries from woodcock bandings provide answers to questions on mortality rates, distribution and magnitude of the harvest, effects of regulations on recovery rates, and the like. For this study, it was also decided to see whether catch data could be used to indicate annual changes in reproductive success; to estimate the summer population on the Refuge; to evaluate summer use of various habitat types; and to determine summer movements and home range. In addition, we continually evaluate the three woodcock capturing techniques to increase their efficiency. The following paragraphs summarize the woodcock catch during the past 4 years and briefly discuss some of the factors responsible.

The number of woodcock handled in 1966 was close to that of 1964 and 1965, the most productive years of the study. Following is a summary of the catch during the 4 years:

Year	New Birds	Returns	Repeats	Total Birds Handled
1963	518	26	185	729
1964	450	33	252	735
1965	285	50	241	576
1966	434	34	255	723
TOTAL	1,687	143	933	2,763

Ground trapping success has held up well (fig. 5). The number of woodcock captured in traps increased in 1966 as it has each year. However, trapping was continued, on a reduced scale, to a later date than in 1964 and 1965.

Mist-netting success improved over 1965, but was lower than in 1963 and 1964 (fig. 6). September rainfall was near normal and usage of night-feeding areas increased.

While there were very few nights when conditions were favorable for night-lighting in 1966, catches on those nights were substantially greater than in 1965. Following is a summary of captures by the three methods over the 4-year period:

Year	Trapping	Netting	Lighting	Total
1963	277	314	138	729
1964	362	209	164	735
1965	378	141	57	576
1966	395	183	145	723
TOTAL	1,412	847	504	2,763

All data from the 4 years of banding have been recorded on IBM punch cards at the Migratory Bird Populations Station. These data have been transferred to tape and the cards moved to the University of Maine computer center for tabulating and analysis. Migratory Bird Populations Station biologists will assist in analyses of population dynamics phases and a series of reports will be published beginning in 1967.

Figure 5.--Netting is attached to top of woodcock ground trap by Student Assistant Patrick Corr and Refuge Biologist Eldon Clark. Wire leads (foreground) extends to another cell of trap. At most trap sites on the Moosehorn National Wildlife Refuge, cover was much heavier (photo by Moosehorn National Wildlife Refuge).

Figure 6.--Students examine a woodcock's wing to determine its sex and age during mist-netting operation. Student assistant Kenneth Lewis (right) will record data (photo by Moosehorn National Wildlife Refuge).

WOODCOCK BANDING STUDIES IN WEST VIRGINIA'S CANAAN VALLEY

Robert C. Kletzly and Joe Rieffenberger
Game Biologists
West Virginia Department of Natural Resources
Davis, West Virginia

During the past 2 years, the authors have been engaged in a woodcock banding program in Canaan Valley, Tucker County, West Virginia (fig. 1). The primary purpose of this program has been to develop effective methods of capturing woodcock so that effects of hunting mortality on the local Canaan Valley woodcock population can be measured. Three hundred and ninety-eight woodcock have been banded (496 handled) during this period through the use of mist nets, ground traps, and night-lighting techniques. Following is a summary of the catch during the past 2 years:

Year	New Birds	Returns	Repeats	Total Birds Handled
1965	101	0	4	105
1966	297	8	86	391
TOTAL	398	8	90	496

Considerable effort has been made to locate woodcock concentrations in both diurnal and nocturnal covers. When a site has been found one or more of the three capture techniques is

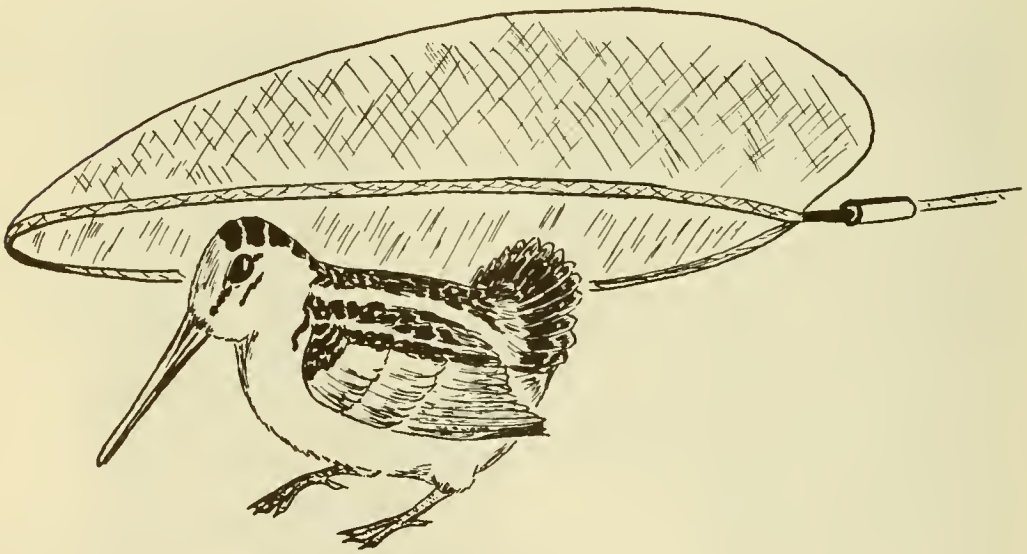
---

Note.--This article is a contribution of Federal Aid in Wildlife Restoration Program, West Virginia Project W-37-R.

used. Success of the various techniques varies with the habitat and climatic conditions present. Following is a summary of captures by the three methods for the past 2 years:

Year	Trapping	Netting	Lighting	Total Birds Handled
1965	19	84	2	105
1966	106	60	225	391
TOTAL	125	144	227	496

It is quite apparent that success is also dependent upon the experience of the investigators. In 1967, more emphasis will be placed on capturing "singing" males and the associated early summer residents of the Valley.



WOODCOCK NIGHT-LIGHTING TECHNIQUES AND EQUIPMENT

Joe Rieffenberger and Robert C. Kletzly
Game Biologists
West Virginia Department of Natural Resources
Davis, West Virginia

During the summer of 1966, the authors were engaged in a woodcock banding study in the Canaan Valley of West Virginia. Night-lighting techniques presently used in Maine (Clark 1966) and Louisiana (Glasgow 1958) proved to be fruitless in this area because the headlamps were too dim to locate and/or "down" flushed woodcock.

The search for a better source of light culminated in the use of a Honda motorcycle battery. A 12-volt, wet-cell battery, weighing about 7 pounds, was rigged with a shoulder strap, an on-off switch, 3 feet of lamp cord, and a sealed beam spotlamp. Since this was a wet-cell battery, the air vent tube was looped to lessen the danger of acid spillage. The battery shown in figure 7 was used a total of 146 hours with daily trickle recharging. Weight and cost of the lamp were minimized by attaching a handle of heavy, insulated copper wire directly to the sealed beam unit, the back of which was painted black.

The net (fig. 7) is a little over 3 feet in diameter. One-inch mesh netting covers this with a bag depth of 4 inches (the object is to pin the bird to the ground). The 6-foot handle has a wooden, finger-fitting grip taped about 1 foot from the end. This allows the operator to tell which way the net is facing without having to take his eyes off the quarry. The hoop and handle are painted a dull black and the netting is dyed a dark color to reduce light reflection.

Note.--This article is a contribution of Federal Aid in Wildlife Restoration Program, West Virginia Project W-37-R.

While walking across a woodcock feeding field (usually a pasture), the operator casts the light back and forth, covering a distance of about 20 yards ahead and to both sides. This distance is increased in heavily grazed sites and reduced to a few feet in areas with heavier ground cover.

After locating (spotting) a woodcock, the approach is made directly and quietly. Care must be taken not to flush additional, unobserved woodcock during the approach as their flight may alarm the individual being pursued. The hand holding the light is extended to prevent illumination of the operator's feet. The net is held vertically during the approach. When close enough, the net is slowly lowered to about belt height and then dropped. Quick action is necessary to pin the bird by hand and prevent injury.

Often a woodcock is flushed without having been seen beforehand. When this occurs, the spotlight is immediately directed at the bird. If the bird circles, the spotter must be careful not to flash the light on any part of himself or the net while tracking it. Silence is "golden" at this time. When the bird is "knocked down," the approach is made as previously described.

During the summer and fall of 1966, a total of 363 manhours of effort resulted in the banding of 177 woodcock, the capture of 6 from previous season's activities, and 42 repeats of prior 1966 captures. An additional 7 birds were killed, mostly by swinging the net instead of letting it drop on the bird by gravity (6 of these mortalities occurred in the first 83 captures while the technique was still being mastered). In addition to these 225 woodcock, 31 snipe and 1 mourning dove were captured with this method.

Fig. 7.--Night-lighting equipment used for capturing woodcock in West Virginia (photo by Edelene Wood).

WOODCOCK BRIEFS FROM HERE 'N THERE

William H. Goudy
Research Biologist
Migratory Bird Populations Station
Laurel, Maryland

Woodcock Singing-Ground Study Initiated in Massachusetts - The Massachusetts Cooperative Wildlife Research Unit will conduct a woodcock singing-ground study during the spring of 1967. The study was conceived by Dr. William G. Sheldon and is designed to determine the incidence of breeding male turnover and replacement on singing grounds. Results of this graduate student research project should clarify population dynamics of the male segment of breeding woodcock populations and thereby provide information on the number of males represented by one occupied singing ground.

Randomization of the Woodcock Singing-Ground Survey - Most routes used in the annual singing-ground survey since 1953 have been established in areas where woodcock were known to be present. Such routes have been altered and/or replaced from time to time as the habitat changed. Since routes are not uniformly distributed in all types of habitat, counts are not representative of woodcock population densities in the various States and Provinces. Furthermore, they may not properly reflect changes in relative numbers of breeding birds from one year to the next (Martin 1962, 1963, and 1964).

This spring (1967), randomly-distributed routes will be conducted in Michigan, West Virginia, Maryland, Delaware, and Pennsylvania. It is hoped that other States and Provinces throughout the woodcock's breeding range will have established randomly-selected routes before 1968. Such surveys would permit a statistically sound, annual assessment of relative densities and fluctuations in the continental population of breeding woodcock.

Woodcock Banding Study Completed in Michigan - Recoveries of banded woodcock provide information on population characteristics that cannot be obtained in any other way. During the past year, a Bureau-sponsored study to develop effective methods of trapping woodcock prior to the hunting season was completed in northern Michigan. Michigan State University graduate student Larry Gregg, with one field assistant, banded over 400 woodcock during his two summers of applied study. This is not only a very creditable accomplishment but also proved the feasibility of establishing a summer banding program in northern Michigan. His investigations indicate that minor habitat manipulations may attract and thereby concentrate woodcock into sites where they can be readily captured.

Woodcock Hunting Mortality Research in West Virginia - One of the most important phases of the woodcock research program during 1966 was the continuation of a population dynamics study by the West Virginia Department of Natural Resources in cooperation with the Bureau. Preliminary results indicate that mortality associated with hunting was approximately 25 percent in the Canaan Valley study area. These data also suggest that there may be differential vulnerability by age and/or sex associated with relatively intense hunting pressure. The size of the Canaan Valley's woodcock population was calculated using kill estimates from bag checks and kill rate estimates from band recoveries. These calculations placed the study area's woodcock population in 1965 and 1966 at about 1,500 resident birds.

Initial Woodcock Seminar Held in Minnesota - A woodcock seminar sponsored jointly by the University of Minnesota and the Bureau of Sport Fisheries and Wildlife was held at the Long Lake Conservation Center near McGregor, Minnesota, during October 1966. Twenty-five participants representing Canadian Provincial, Federal and State agencies, private conservation organizations and universities, and several interested individuals gave the meeting a broad base.

The objectives of the seminar were three-fold:

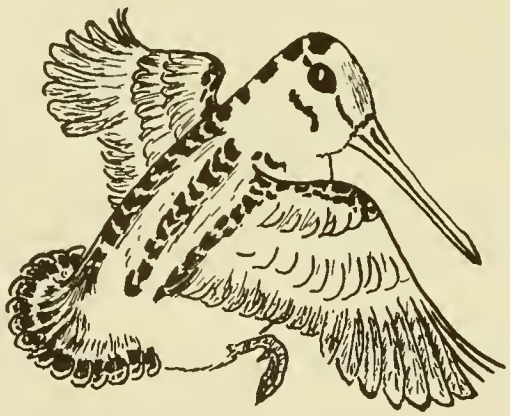
1. To review the American Woodcock Research and Management Program report prepared in January 1966.

2. To further develop the research project recommendations contained in the above report.

3. To explore in more detail the problems of funding woodcock research and management proposals at the National, State, and university level.

Minutes of this meeting may be obtained by writing to the Section of Migratory Upland Game Bird Studies, Migratory Bird Populations Station, Laurel, Maryland 20810.

Woodcock Seminar Planned for 1968 - The second seminar on American woodcock research and management activities is tentatively scheduled for January 1968 in Louisiana. The exact location(s) and dates have not yet been established but should be announced in September. It is planned that much of this seminar will be devoted to night banding operations and field investigations of primary woodcock wintering habitat. The sponsors (Louisiana Wild Life and Fisheries Commission, Louisiana State University, and the Bureau of Sport Fisheries and Wildlife) will forward invitations to representatives of Provincial, Federal, and State agencies, private conservation organizations, and universities. Interested individuals should contact the sponsoring organizations for further information.



REFERENCES

BLANKENSHIP, L. H.
1957. Investigations of the American woodcock in Michigan. Michigan Conservation Department, Game Division, Lansing. Report 2123. 217p.

CLARK, E. R.
1966. Woodcock capture techniques and population studies at Moosehorn National Wildlife Refuge. Proceedings of the N.E. Section of the Wildlife Society, Boston, Massachusetts --- January 16-19, 1966. 8p.

DUKE, G. E.
1966. Reliability of censuses of singing male woodcocks. Journal of Wildlife Management. Vol. 30, No. 4, P-697-707.

GLASGOW, L. L.
1958. Contributions to the knowledge of the American woodcock Philohela minor (Gmelin), on the wintering range in Louisiana. Unpublished Ph.D. Thesis, Agriculture and Mechanical College of Texas. 159p.

GOUDY, W. H.
1960. Factors affecting woodcock spring population indexes in southern Michigan. Michigan Conservation Department, Game Division, Lansing. Report 2281. 44p.

_____ and F. W. MARTIN.
1966. Woodcock status report, 1965. Bureau of Sport Fisheries and Wildlife, Special Scientific Report —— Wildlife No. 92. 43p.

MARTIN, F. W.
1961. Woodcock status report, 1961. Bureau of Sport Fisheries and Wildlife, Special Scientific Report —— Wildlife No. 58. 29p.

_____.
1962. Woodcock status report, 1962. Bureau of Sport Fisheries and Wildlife, Special Scientific Report —— Wildlife No. 69. 36p.

_____.
1963. Woodcock status report, 1963. Bureau of Sport Fisheries and Wildlife, Special Scientific Report —— Wildlife No. 76. 43p.

_____.
1964. Woodcock status report, 1964. Bureau of Sport Fisheries and Wildlife, Special Scientific Report —— Wildlife No. 88. 43p.

_____ and E. R. CLARK.
1964. Summer bandings of woodcock, 1962-1963. Administrative Report No. 43. Migratory Bird Populations Station, U. S. Department of the Interior. 9p.

MENDALL, H. L., and C. M. ALDOUS.
1943. The ecology and management of the American woodcock. Maine Cooperative Wildlife Research Unit, Orono. 201p.

ROBBINS, C. S.
1960. Woodcock status report, 1960. Bureau of Sport Fisheries and Wildlife, Special Scientific Report —— Wildlife No. 50. 26p.

☆ U S GOVERNMENT PRINTING OFFICE : 1967 O—265-487

The Department of the Interior, created in 1849, is a Department of Conservation, concerned with management, conservation, and development of the Nation's water, wildlife, fish, mineral, forest, and park and recreational resources. It has major responsibilities also for Indian and Territorial affairs.

As America's principal conservation agency, the Department works to assure that nonrenewable resources are developed and used wisely, that park and recreational resources are conserved for the future, and that renewable resources make their full contribution to the progress, prosperity, and security of the United States, now and in the future.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
WASHINGTON, D. C. 20240

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF THE INTERIOR